IEEE P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| TPC, Operating Classes and Channel Switching | | | | |
| Date: 2012-03-09 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Brian Hart | Cisco Systems | 170 W Tasman Dr, San Jose, CA 95134, USA |  | [brianh@cisco.com](mailto:brianh@cisco.com) |

##### Abstract:

##### Change sets 1-6 address CIDs 4248, 4252, 4257, 4258, 4259, 4260 and 4346 using 11acD2.0 as the baseline.

##### Change set 7 addresses 4249 (not completed in R0)

##### Changes indicated by a mixture of Word track-changes and instructions. For equation changes, Tex notation is sometimes used. E.g. a\_{xyz}^b denotes axyzb

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4248 | Brian Hart | 10.8 | 136 | 1 | Units of power control are undefined of Max Power Env (ditto for fields in country element) | Fix. Commenter will bring presentation | Revised. See 12/0379r0 |
| 4252 | Brian Hart | 3.2 | 34 | 5 | Definitionf transmit power in the baseline is very ambiguous for countries (or regs within a country) where TX power is not so regulated as EIRP | P#, SC, LN from 11mbD12. Fix. Commenter will bring presentation | Revised. See 12/0379r0 |
| 4257 | Brian Hart | 8.5.2.6 | 77 | 22 | AP does not have a way to switch ch and power at the same time. Likely to be important for TDWR spectrum | Fix. Commenter will bring presentation | Revised. See 12/0379r0 |
| 4258 | Brian Hart | 8.5.2.6 | 77 | 22 | AP does not have a way to switch ch and op class at the same time. Likely to be important for TDWR spectrum | Fix. Commenter will bring presentation | Revised. See 12/0379r0 |
| 4259 | Brian Hart | 8.3.3.2 | 38 | 1 | VHT only allows wide ch bw element in CSA frame. Needs to be allowed in ECSA, beacon and probe response | Fix. Commenter will bring presentation | Revised. See 12/0379r0 |
| 4260 | Brian Hart | 8.5.2.6 | 77 | 22 | (Minor) AP on school bus crossing from US to Mexico and vice versa daily cannot switch countries during a channel switch | Fix. Commenter will bring presentation | Revised. See 12/0379r0 |
| 4346 | Brian Hart | 8.5.2.6 | 77 | 22 | 1) Also need to allow Wide BW Ch SW element in beacons, probe responses and ECSA frames; 2) No ability provided to change ch and TX power at the same time, which may be important for TDWR spectrum; or change operating class; or country; or country table | Fix. Commenter will bring presentation | Revised. See 12/0379r0 |

***Discussion*:** See 12/0297. High priority items are addressed in this document.

***Change Set 1*: Units for Power Control**

**Table 8-54—Element IDs**

|  |  |  |  |
| --- | --- | --- | --- |
| VHT Transmit Power Envelope (see 8.4.2.164 (VHT Transmit Power Envelope element)) | 195 | 5 to 8 | Yes |

**8.4.2.164 VHT Transmit Power Envelope element**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | The Channel Center Frequency Segment field and Segment Channel Width field pair are repeated as needed | | Optional |
|  | Element ID | Length | Maximum Transmit Power | Channel Center Frequency Segment | Segment Channel Width | Transmit Power Information |
| Octets: | 1 | 1 | 1 | 1 | 1 | 0 or 1 |

The Length field, which is 1 octet in length, is variable and depends on the number of Channel Center Frequency Segment field and Segment Channel Width field pairs. A Channel Center Frequency Segment field and Segment Channel Width field pair is present per frequency segment. A Length field value of 5 or 6 indicates a single (contiguous) frequency segment that contains the Primary 20 MHz subchannel. A Length field value of 7 or 8 indicates two (non-contiguous) frequency segments. A Length field value of 6 or 8 indicates that the Transmit Power Information field is present, otherwise it is not present.

The Channel Center Frequency Segment field, which is 1 octet in length, is set to the channel number corresponding to the channel center frequency of each segment (see Table 8-183w (VHT Operation Information subfields)).

The Segment Channel Width field, which is 1 octet in length, is set to the number of channels in the frequency segment.

***TGac editor: using your editorial powers, please move this Max TX Power paragraph earlier, to immediately after the length field description (i.e. in order). Not done here, just to reduce edits.***

The Maximum Transmit Power field defines the maximum transmit power limit of the transmission bandwidth defined by the VHT Transmit Power Envelope element. The Maximum Transmit Power field is an 8-bit 2's complement signed integer in the range of -64 dBm to 63.5 dBm with a 0.5 dB step.

The format of the Transmit Power Information field is defined in Figure Table 8-yyyyNEW-1.

Figure 8-yyyyNEW-1: Format of Transmit Power Information field

|  |  |  |
| --- | --- | --- |
|  | Maximum Transmit Power Units Interpretation | Reserved |
| Bits: | 0 3 | 4 7 |

The Maximum Transmit Power Units Interpretation subfield provides additional interpretation for the units of the Maximum Transmit Power field and is defined in Table 8-yyyyNEW-2. If the Maximum Transmit Power Units Interpretation subfield is not present, then the units of the Maximum Transmit Power field is interpreted according the regulations applicable for the indicated frequency segments in the domain identified by the Country String in the Country element sent in Beacon frames for the BSS. If no Country element is present, then the units interpretation is EIRP.

Table 8-yyyyNEW-2: Definition of Maximum Transmit Power Units Interpretation subfield

|  |  |
| --- | --- |
| Value | Units Interpretation of the Maximum Transmit Power field |
| 0 | EIRP |
| 1 | Conducted, summed across all antenna inputs |
| 2 | EIRP/MHz |
| 3 | Conducted/MHz, summed across all antenna inputs |
| 4-15 | Reserved |

***Change Set 2*: Clean-up of definition of Transmit Power**

**3.2 Definitions specific to IEEE 802.11**

**8.4.2.17 Power Capability element**

The Minimum Transmit Power Capability field is set to the nominal minimum transmit power with which the STA is capable of transmitting in the current channel, with a tolerance ± 5 dB. The field is coded as a signed integer in units of decibels relative to 1 mW.Further interpretation of this field is defined in 10.8.2 (Association based on transmit power capability).

The Maximum Transmit Power Capability field is set to the nominal maximum transmit power with which the STA is capable of transmitting in the current channel, with a tolerance ± 5 dB. The field is coded as a signed integer in units of decibels relative to 1 mW. Further interpretation of this field is defined in 10.8.2 (Association based on transmit power capability).

**8.4.2.70.4 Peer-to-Peer Link event report**

The STA Tx Power field indicates the target transmit power at the antenna (i.e. EIRP) in dBm with a tolerance of ± 5 dB of the lowest basic rate of the reporting STA.

**8.4.2.71.5 Diagnostic Information subelement descriptions**

The Tx Power field indicates the target transmit power level(s) at the antenna(s) (i.e. EIRP), where the actual power is within ±5 dB to the target. Each transmit power level is encoded in a single octet as a 2’s complement value in dBm, rounded to the nearest integer. If the Tx Power Mode field is 0 then the Tx Power field contains one or more transmit power levels in increasing numerical order. If the Tx Power Mode field is 1, the Tx Power field contains the STA’s minimum and nonzero maximum transmit power levels, in that order.

**8.4.2.73.5 Radio Information subelement**

The Transmit Power field is the transmit power used to transmit the current Location Track Notification

frame containing the Location Parameters element with the Radio Information subelement and is a signed

integer, one octet in length, reported as an EIRP in dBm. A value of –128 indicates that the transmit power is unknown. The tolerance for the transmit power value reported in the Radio Information subelement is ± 5 dB. This tolerance is defined as the maximum possible difference, in decibels, between the reported power value and the total transmitted power across all antennas of the STA, which are measured when transmitting Location Request frames.

**10.8.2 Association based on transmit power capability**

A STA shall provide an AP with its minimum and maximum transmit power capability for the current channel when associating or reassociating, using a Power Capability element in Association Request frames or Reassociation Request frames. An AP may use the minimum and maximum transmit power capability of associated STAs as an input into the algorithm used to determine the local transmit power constraint for any BSS it maintains. The specification of the algorithm is beyond the scope of this standard.

An AP may reject an association or reassociation request from a STA if it considers the STA’s minimum or maximum transmit power capability to be unacceptable. For example, a STA’s power capability might be unacceptable if it violates local regulatory constraints or increases the probability of hidden STAs by a significant degree. The criteria for accepting or rejecting an association or reassociation on the basis of transmit power capability are beyond the scope of this standard.

If the Beacon or Probe Response most recently received by a VHT STA from an AP includes a VHT Transmit Power Envelope element, then the units of the Minimum Transmit Power Capability and Maximum Transmit Power Capability fields within the Power Capability element sent in the STA’s (Re)Association Request frame to the AP shall be interpreted in the same manner as the units of the Maximum Transmit Power field in the VHT Transmit Power Envelope element (see 8.4.2.164 (VHT Transmit Power Envelope element)) sent in the Beacon or Probe Response.

***Change Set 3*:Channel Switch information in Beacon and Probe Response**

**Table 8-20—Beacon frame body**

|  |  |  |
| --- | --- | --- |
| 66 | Channel Switch Wrapper element | The Channel Switch Wrapper element is optionally present if  dot11VHTOptionImplemented is true, and at one of  a Channel Switch Announcement element or a Extended Chanel Switch Announcement element is also present in the Beacon frame |

**Table 8-27—Probe Response frame body**

|  |  |  |
| --- | --- | --- |
| 67 | Channel Switch Wrapper element | The Channel Switch Wrapper element is optionally present if  dot11VHTOptionImplemented is true, and at one of  a Channel Switch Announcement element or a Extended Chanel Switch Announcement element is also present in the Probe Response frame |

**Table 8-54—Element IDs**

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Switch Wrapper (see 8.4.2.xxxNew) | <To be assigned by ANA> | 7 to 257 | Subelements |

**8.4.2.<editorToAssign> Channel Switch Wrapper element**

The Channel Switch Wrapper contains sub-elements that indicate characteristics of the BSS after a channel switch. The format of the Channel Switch Wrapper element is defined in Figure 8-yyyyNEW-3.

Figure 8-yyyyNEW-3: Format of the Channel Switch Wrapper element

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | One | Zero or one |  |  |
|  | Element ID | Length |  | Secondary Channel Offset subelement | Wide Bandwidth Channel Switch subelement |  |  |
| Octets |  |  |  | 3 | Variable |  |  |

***Note to reader: the highlight text above is changed in a later change set.***

The Secondary Offset subelement is present when channel switching to a channel width wider than 20 MHz; otherwise this subelement is not present. The format of the Secondary Channel Offset subelement is defined to be the same as the Secondary Offset element (see 8.4.2.22). The Secondary Offset subelement indicates the relative position of the primary 20 MHz and secondary 20 MHz channels after channel switching (see 10.38.1). The Wide Bandwidth Channel Switch subelement is present when channel switching to a channel width wider than 40 MHz; otherwise this subelement is not present. The format of the Wide Bandwidth Channel Switch subelement is defined to be the same as the Wide Bandwidth Channel Switch element (see 8.4.2.163). The Wide Bandwidth Channel Switch subelement indicates the BSS operating bandwidth after channel switching (see 10.38.1).

**10.38.1 Basic VHT BSS functionality**

A VHT AP announces a switch of operating channel, operating bandwidth or both, by either

— using the Channel Switch Announcement Element, Channel Switch Announcement Frame or both, following the procedure described in 10.9.8.2 (Selecting and advertising a new channel in an infrastructure BSS)

— using the Extended Channel Switch Announcement Element, Extended Channel Switch Announcement Frame or both, following the procedure described in 10.10 (Extended channel switching

(ECS)) and in addition following the procedures in this section.

The New Channel Number field in the Channel Switch Announcement Element, Extended Channel Switch Announcement Element, Channel Switch Announcement Frame or Extended Channel Switch Announcement Frame, identifies the primary 20 MHz channel after the switch. The value of the New Channel Number field is set equal to dot11CurrentPrimaryChannel (see 22.3.14 (Channelization)) after the switch.

When announcing a switch to a 40 MHz operating bandwidth, either in conjunction with a channel switch or alone, the Secondary Channel Offset Element or the Channel Switch Wrapper element, which contains a Secondary Channel Offset subelement, shall be present in the same frame as the Channel Switch Announcement element.

NOTE—The indicated operating class within the Extended Channel Switch Announcement element or frame identifies the bandwidth and the relative position of the primary 20 MHz and secondary 20 MHz channels, hence a Secondary Channel Offset Element is not required when the Extended Channel Switch Announcement element only is used.

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth, either in conjunction with a channel switch or alone, either a) both the Secondary Channel Offset element and the Wide Bandwidth Channel Switch element or b) a Channel Switch Wrapper element that contains both a Secondary Channel Offset subelement and the Wide Bandwidth Channel Switch subelement shall be present in the same frame as the Channel Switch Announcement element or Extended Channel Switch Announcement element. When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz by using the Extended Channel Switch Announcement element, the value of the New Operating Class field identifies the primary 40 MHz channel.

The Wide Bandwidth Channel Switch element or subelement shall not be present in a frame or element unless the Secondary Channel Offset element or subelement is also present, respectively.

If neither a) the Secondary Channel Offset element nor b) a Channel Switch Wrapper element that contains a Secondary Channel Offset subelement are present within the same frame where a Channel Switch Announcement Element is present, the operating bandwidth after the switch is 20 MHz.

An Extended Channel Switch Announcement frame shall not be used to switch to an operating bandwidth

greater than 40 MHz.

***Note to reader: the highlight text above is changed in a later change set.***

***Change Set 4*: TPC Information in Channel Switch**

**8.4.2.<editorToAssign> Channel Switch Wrapper element**

The Channel Switch Wrapper contains sub-elements that indicate characteristics of the BSS after a channel switch. The format of the Channel Switch Wrapper element is defined in Figure 8-yyyyNEW-3.

Figure 8-yyyyNEW-3: Format of the Channel Switch Wrapper element

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | One | Zero or one | Zero or one | Zero or one |
|  | Element ID | Length |  | Secondary Channel Offset subelement | Wide Bandwidth Channel Switch subelement | New VHT Transmit Power Envelope subelement | New Extended Power Constraint subelement |
| Octets |  |  |  | 3 | Variable | Variable | Variable |

The New VHT Transmit Power Envelope subelement is optionally present. The New VHT Transmit Power Envelope subelement is defined to have the same format as the VHT Transmit Power Envelope element (see 8.4.2.164).If present, the New VHT Transmit Power Envelope subelement indicates a maximum transmit power for the BSS for an indicated bandwidth after channel switching (see 10.38.1).

The New Extended Power Constraint subelement is optionally present if the New VHT Transmit Power Envelope subelement is also present; otherwise the New Extended Power Constraint subelement is not present. The format of the New Extended Power Constraint subelement is defined to have the same format as the Extended Power Constraint element (see 8.4.2.165) yet (Channel Width, Local Power Constraint)-tuples for 20 MHz and 40 MHz are allowed. If present, the New Extended Power Constraint subelement combines with the New VHT Transmit Power Envelope subelement to indicate local power constraint(s) after channel switching (see 10.38.1).

8.5.2.6 Channel Switch Announcement frame format

***Change Figure 8-436 as follows (adding Wide Bandwidth Channel Switch, New VHT Transmit Power Envelope and New Extended Power Constraint elements):***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | Zero or one | Zero or one | Zero or one |
|  | Category | Spectrum Management Action | Channel Switch Announcement element | Secondary Channel Offset element | Mesh Channel Switch Parameters element | Wide Bandwidth Channel Switch element | New VHT Transmit Power Envelope element | New Extended Power Constraint element |
| Octets: | 1 | 1 | 5 | 3 | 6 | 5 | Variable | Variable |

***Change the last 2 paragraphs of this subclause and insert subsequent paragraphs as follows:***

The Secondary Channel Offset element is defined in 8.4.2.22 (Secondary Channel Offset element). This element is present when switching to a 40 MHz or wider channel (in which case the Secondary Channel Offset field of this element represents the position of the secondary 20 MHz channel relative to the primary 20 MHz channel). It may be present when switching to a 20 MHz channel (in which case the Secondary Channel Offset field is set to SCN).

The Mesh Channel Switch Parameters element is defined in 8.4.2.105. This element is present when a mesh STA performs an MBSS channel switch. Otherwise, t~~T~~he Mesh Channel Switch Parameters element is not present ~~included for channel switch other than MBSS~~.

The Wide Bandwidth Channel Switch element is defined in 8.4.2.163 (Wide Bandwidth Channel Switch element). This information element is present when switching to a channel width wider than 40 MHz.

The New VHT Transmit Power Envelope element is optionally present. The New VHT Transmit Power Envelope element is defined to have the same format as the VHT Transmit Power Envelope element (see 8.4.2.164). If present, the New VHT Transmit Power Envelope element indicates a maximum transmit power for the BSS for an indicated bandwidth after channel switching (see 10.38.1).

The New Extended Power Constraint element is optionally present if the New VHT Transmit Power Envelope element is also present; otherwise the New Extended Power Constraint element is not present. The format of the New Extended Power Constraint element is defined to have the same format as the Extended Power Constraint element (see 8.4.2.165) yet (Channel Width, Local Power Constraint)-tuples for 20 MHz and 40 MHz are allowed. If present, the New Extended Power Constraint element combines with the New VHT Transmit Power Envelope element to indicate local power constraint(s) after channel switching (see 10.38.1).

**10.38.1 Basic VHT BSS functionality**

A VHT AP announces a switch of operating channel, operating bandwidth or both, by either

— using the Channel Switch Announcement Element, Channel Switch Announcement Frame or both, following the procedure described in 10.9.8.2 (Selecting and advertising a new channel in an infrastructure BSS)

— using the Extended Channel Switch Announcement Element, Extended Channel Switch Announcement Frame or both, following the procedure described in 10.10 (Extended channel switching

(ECS)) and in addition following the procedures in this section.

A VHT AP may also announce new TPC parameters for the BSS that come into effect at the same time as the switch of operating channel, operating bandwidth, or both.

The New Channel Number field in the Channel Switch Announcement Element, Extended Channel Switch Announcement Element, Channel Switch Announcement Frame or Extended Channel Switch Announcement Frame, identifies the primary 20 MHz channel after the switch. The value of the New Channel Number field is set equal to dot11CurrentPrimaryChannel (see 22.3.14 (Channelization)) after the switch.

When announcing a switch to a 40 MHz operating bandwidth, either in conjunction with a channel switch or alone, the Secondary Channel Offset Element or the Channel Switch Wrapper element, which contains a Secondary Channel Offset subelement, shall be present in the same frame as the Channel Switch Announcement element.

NOTE—The indicated operating class within the Extended Channel Switch Announcement element or frame identifies the bandwidth and the relative position of the primary 20 MHz and secondary 20 MHz channels, hence a Secondary Channel Offset Element is not required when the Extended Channel Switch Announcement element only is used.

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth, either in conjunction with a channel switch or alone, either a) both the Secondary Channel Offset element and the Wide Bandwidth Channel Switch element or b) a Channel Switch Wrapper element that contains both a Secondary Channel Offset subelement and the Wide Bandwidth Channel Switch subelement shall be present in the same frame as the Channel Switch Announcement element or Extended Channel Switch Announcement element. When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz by using the Extended Channel Switch Announcement element, the value of the New Operating Class field identifies the primary 40 MHz channel.

The Wide Bandwidth Channel Switch element or subelement shall not be present in a frame or element unless the Secondary Channel Offset element or subelement is also present, respectively.

If neither a) the Secondary Channel Offset element nor b) a Channel Switch Wrapper element that contains a Secondary Channel Offset subelement are present within the same frame where a Channel Switch Announcement Element is present, the operating bandwidth after the switch is 20 MHz.

An Extended Channel Switch Announcement frame shall not be used to switch to an operating bandwidth

greater than 40 MHz.

A VHT AP announces new TPC parameters for the BSS, that come into effect at the same time as the switch of operating channel, operating bandwidth, or both, by including a) one VHT Transmit Power Envelope element and optionally an Extended Power Constraint element in a Channel Switch Announcement frame and b) a VHT Transmit Power Envelope subelement and optionally an Extended Power Constraint subelement in a Channel Wrapper element in Beacon and Probe Response frames. A STA that maintains association with the AP after the switch shall use the parameters in these elements and subelements received from the AP in the STA’s TPC calculations for the new operating channel and operating bandwidth (see 10.8 (TPC procedures)).

***Change Set 5*: Worldwide operating classes where possible**

Table E-1—Operating classes in the United States

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ~~34~~-35-127 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| 128 | 128 | 5 | 80 | - | 42, 58, 106, 122, 138, 155 |  |
| 129 | 129 | 5 | 160 | - | 50, 114 |  |
| 130-255 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

Table E-2—Operating classes in Europe

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ~~18~~19-127 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| 128 | 128 | 5 | 80 | - | 42, 58, 106, 122 |  |
| 129 | 129 | 5 | 160 | - | 50, 114 |  |
| 130-255 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

Table E-3—Operating classes in Japan

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| ~~60~~60-127 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| 128 | 128 | 5 | 80 | - | 42, 58, 106, 122 |  |
| 129 | 129 | 5 | 160 | - | 50, 114 |  |
| 130-255 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

***Change Set 6*: Clarify Country element, fix Extended Channel Switching, introduce operating class for 80+80**

**8.4.2.10 Country element**

The Country element contains the information required to allow a STA to identify the regulatory domain in which the STA is located and to configure its PHY for operation in that regulatory domain. The format of this element is as shown in Figure 8-90.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Country String | Triplet field |  |  | Pad (if needed) |
| Octets: | 1 | 1 | 3 | Q\*3 |  |  | 0 or 1 |

Figure 8-90—Country element format

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1 Subband Triplet sequence, made up of Q Subband triplets, Q >= 1 | | |
|  | Subband triplet | | |
|  | First Channel Number/ Operating Extension Identifier | Number of Channels | Maximum Transmit Power Level |
| Octets: | 1 | 1 | 1 |

Figure 8-90xxxNEW-4—Triplet field format if dot11OperatingClassesRequired is false

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | M Operating/Subband Sequences, indexed by m = 1, 2, … M), M >= 1 | | | | | |
|  | Operating/Subband Sequence | | | | | |
|  | 1 Operating triplet | | | 1 Subband Triplet sequence, made up of P(m) Subband triplets, where P(m) >= 0 | | |
|  | Operating triplet | | | Subband triplet | | |
|  | First Channel Number/ Operating Extension Identifier | Operating Class | Coverage Class | First Channel Number/ Operating Extension Identifier | Number of Channels | Maximum Transmit Power Level |
| Octets: | 1 | 1 | 1 | 1 | 1 | 1 |

Figure 8-90xxxNEW-5—Triplet field format if dot11OperatingClassesRequired is true

The element ID for this element is set to the value for Country, specified in Table 8-54. The length of the

element is variable, as the element contains the variable-length Triplet field.

If dot11OperatingClassesRequired is false, then the Triplet field is a single Subband Triplet sequence that is composed of Q Subband triplets, where Q is one or more, as shown in Figure 8-90xxxNEW-4.

If dot11OperatingClassesRequired is true, then the Triplet field is composed of one or more Operating/Subband Sequences, as shown in Figure 8-90xxxNEW-5. Each Operating/Subband Sequence is composed of one Operating triplet followed by one Subband Triplet sequence. Each Subband Triplet sequence is composed of zero or more Subband triplets. The number of triplets in the Triplet field is Q = sum\_{m=1}^{M} 1+P(m).

The number Q of Subband or Operating triplets in the element is determined by the Length field.

An operating class for an 80+80 channel bandwidth is expressed by two consecutive Operating/Subband Sequences, where the first Operating/Subband Sequence contains an Operating Triplet for an 80 MHz Channel Spacing without a +80 Behavior Limit and the second Operating/Subband Sequence contains an Operating Triplet for an 80 MHz Channel Spacing with a +80 Behavior Limit.

Operating/Subband Sequences for 80, 160 or 80+80 MHz operating classes contain zero subband triplets.

NOTE – The VHT Transmit Power Envelope element is always used instead.

The First Channel Number/ Operating Extension Identifier field is 1 octet field containing an unsigned integer. In a Subband triplet, the First Channel Number/ Operating Extension Identifier field has a value less than or equal to 200, and is referred to as the First Channel Number field. In an Operating triplet, the First Channel Number/ Operating Extension Identifier field has a value of 201 or greater, and is referred to as an Operating Extension Identifier field.

The minimum length of the element is 8 octets.

The Country String field of the element is 3 octets in length. The AP and mesh STA set this field to the value contained in the dot11CountryString attribute before transmission in a Beacon or Probe Response frame. Upon reception of this element, a STA sets the value of the dot11CountryString to the value contained in this field.

The First Channel Number field indicates the lowest channel number in the Subband triplet. The group of channels described by each pair of the First Channel Number and the Number of Channels fields within a Subband Triplet sequence do not have overlapping channel identifiers. [For example, the pairs (2,4) and (5,2) overlap and are not used within the same Subband Triplet sequence.]

The First Channel Numbers are monotonically increasing within a Subband Triplet sequence.

The Number of Channels field of the subelement is 1 octet in length.

The Maximum Transmit Power Level field is a signed number and is 1 octet in length. The Maximum Transmit Power Level field indicates the maximum power, in dBm, allowed to be transmitted. As the method of measurement for maximum transmit power level differs by regulatory domain, the value in this field is interpreted according to the regulations applicable for the domain identified by the Country String.

An operating class is an index into a set of values for radio equipment sets of rules. The Operating Class

field is 1 octet in length.

A coverage class is an index into a set of values for aAirPropagationTime. The Coverage Class field is 1

octet in length.

The Coverage Class field of the operating triplet specifies the aAirPropagationTime characteristic used in

BSS operation, as shown in Table 8-56. The characteristic aAirPropagationTime describes variations in

actual propagation time that are accounted for in a BSS and, together with maximum transmit power level, allow control of BSS diameter.

The Pad field is 0 or 1 octet in length. The length of the Country element is evenly divisible by 2. The Pad is used to add a single octet to the element if the length is not evenly divisible by 2. The value of the Pad field is 0.

Figure 8-yyyyNEW-3: Format of the Channel Switch Wrapper element

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Zero or one | One | Zero or one | Zero or one | Zero or one |
|  | Element ID | Length | New Country element | Secondary Channel Offset subelement | Wide Bandwidth Channel Switch subelement | New VHT Transmit Power Envelope subelement | New Extended Power Constraint subelement |
| Octets |  |  | Variable | 3 | Variable | Variable | Variable |

The New Country subelement is present when an AP performs extended channel switching to a new Country, Operating Class Table or a changed set of Operating Classes relative to the contents of the Country element sent in the Beacon; otherwise this subelement is not present. The format of the New Country subelement is defined to be the same as the format of the Country element (see 8.4.2.10 (Country element)), except that no subband triplets are present in the New Country subelement. The Country string within the New Country subelement indicates the Country and Operating Class Table of the BSS after extended channel switching and operating triplets within the New Country subelement indicate the operating classes of the BSS after extended channel switching (see 10.38.1).

**8.5.8.7 Extended Channel Switch Announcement frame format**

The Extended Channel Switch Announcement frame is transmitted by an AP in an infrastructure BSS, a STA in an IBSS, or a mesh STA in an MBSS to advertise a channel switch. The format of the Extended Channel Switch Announcement frame Action field is shown in Figure 8-449.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  | Zero or one | Zero or one | Zero or one | Zero or one |
|  | Category | Public Action | Channel Switch Mode | New Operating Class | New Channel Number | Channel Switch Count | Mesh Channel Switch Parameters element | New Country element | Wide Bandwidth Channel Switch element | New VHT Transmit Power Envelope element | New Extended Power Constraint element |
| Octets: | 1 | 1 | 1 | 1 | 1 | 1 | 6 | Variable | 5 | Variable | Variable |

The Category field is set to the value for public action defined in Table 8-38.

The Public Action field is set to indicate an Extended Channel Switch Announcement frame, as defined in

Table 8-210.

The Channel Switch Mode, New Operating Class, New Channel Number, and Channel Switch Count fields are as described in the Extended Channel Switch Announcement element (see 8.4.2.55).

Mesh Channel Switch Parameters element is defined in 8.4.2.105. This element is present when a mesh STA performs MBSS channel switch. The Mesh Channel Switch Parameters element is not included for channel switch other than the MBSS channel switch.

New Country subelement is present when an AP performs extended channel switching to a new Country, Operating Class Table or a changed set of Operating Classes relative to the contents of the Country element sent in the Beacon; otherwise this subelement is not present. The format of the New Country subelement is defined to be the same as the format of the Country element (see 8.4.2.10 (Country element)), except that no subband triplets are present in the New Country subelement. The Country string within the New Country subelement indicates the Country and Operating Class Table of the BSS after extended channel switching and operating triplets within the New Country subelement indicate the operating classes of the BSS after extended channel switching (see 10.38.1).

This Wide Bandwidth Channel Switch element is present when extended channel switching to a channel width wider than 40 MHz; otherwise this element is not present. The Wide Bandwidth Channel Switch element is defined in 8.4.2.163 (Wide Bandwidth Channel Switch element). The Wide Bandwidth Channel Switch element indicates the BSS operating bandwidth after extended channel switching (see 10.38.1).

The New VHT Transmit Power Envelope element is optionally present. The New VHT Transmit Power Envelope element is defined to have the same format as the VHT Transmit Power Envelope element (see 8.4.2.164). If present, the New VHT Transmit Power Envelope element indicates a maximum transmit power for the BSS for an indicated bandwidth after extended channel switching (see 10.38.1).

The New Extended Power Constraint element is optionally present if the New VHT Transmit Power Envelope element is also present; otherwise the New Extended Power Constraint element is not present. The format of the New Extended Power Constraint element is defined to have the same format as the Extended Power Constraint element (see 8.4.2.165) yet (Channel Width, Local Power Constraint)-tuples for 20 MHz and 40 MHz are allowed. If present, the New Extended Power Constraint element combines with the New VHT Transmit Power Envelope element to indicate local power constraint(s) after channel switching (see 10.38.1).

**10.38.1 Basic VHT BSS functionality**

A VHT AP announces a switch of operating channel, operating bandwidth or both, by either

— using the Channel Switch Announcement Element, Channel Switch Announcement Frame or both, following the procedure described in 10.9.8.2 (Selecting and advertising a new channel in an infrastructure BSS)

— using the Extended Channel Switch Announcement Element, Extended Channel Switch Announcement Frame or both, following the procedure described in 10.10 (Extended channel switching

(ECS)) and in addition following the procedures in this section.

A VHT AP may also announce a new Country string (including a new Operating Table index), new operating classes or new TPC parameters for the BSS that come into effect at the same time as the switch of operating channel, operating bandwidth, or both.

The New Channel Number field in the Channel Switch Announcement Element, Extended Channel Switch Announcement Element, Channel Switch Announcement Frame or Extended Channel Switch Announcement Frame, identifies the primary 20 MHz channel after the switch. The value of the New Channel Number field is set equal to dot11CurrentPrimaryChannel (see 22.3.14 (Channelization)) after the switch.

When announcing a switch to a 40 MHz operating bandwidth, either in conjunction with a channel switch or alone, the Secondary Channel Offset Element or the Channel Switch Wrapper element, which contains a Secondary Channel Offset subelement, shall be present in the same frame as the Channel Switch Announcement element.

NOTE 1—The indicated operating class within the Extended Channel Switch Announcement element or frame identifies the bandwidth and the relative position of the primary 20 MHz and secondary 20 MHz channels, hence a Secondary Channel Offset Element is not required when the Extended Channel Switch Announcement element only is used.

NOTE 2 – The above procedure to switch to a 40 MHz operating bandwidth is likely to be understood by HT STAs as a switch to a 20 MHz bandwidth since they are not required to recognize the Channel Switch Wrapper element.

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth, either in conjunction with a channel switch or alone, either a) both the Secondary Channel Offset element and the Wide Bandwidth Channel Switch element or b) a Channel Switch Wrapper element that contains both a Secondary Channel Offset subelement and the Wide Bandwidth Channel Switch subelement shall be present in the same frame as the Channel Switch Announcement element or Extended Channel Switch Announcement element. When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz by using the Extended Channel Switch Announcement element or Extended Channel Switch Announcement frame, a) the value of the New Operating Class field identifies the primary 40 MHz channel and b) Operating triplets within the New Country subelement or subelement respectively indicates additional operating class(es) for the switched BSS.

The Wide Bandwidth Channel Switch element or subelement shall not be present in a frame or element unless the Secondary Channel Offset element or subelement is also present, respectively.

If neither a) the Secondary Channel Offset element nor b) a Channel Switch Wrapper element that contains a Secondary Channel Offset subelement are present within the same frame where a Channel Switch Announcement Element is present, the operating bandwidth after the switch is 20 MHz.

A VHT AP announces new TPC parameters for the BSS, that come into effect at the same time as the switch of one or more of Country string (including Operating Table index), operating classes, operating channel or operating bandwidth, by including a) one or more VHT Transmit Power Envelope elements and optionally an Extended Power Constraint element in a Channel Switch Announcement frame or Extended Channel Switch Announcement frame and b) one or more VHT Transmit Power Envelope subelements and optionally an Extended Power Constraint subelement in a Channel Wrapper element. A STA that maintains association with the AP after the switch shall use the parameters in these elements and subelements received from the AP in the STA’s TPC calculations for the new operating channel and operating bandwidth (see 10.8 (TPC procedures)).

A VHT AP announces a new Country string (including Operating Table index), new operating classes or both for the BSS, that come into effect at the same time as the channel switch, by including a) a New Country element in an Extended Channel Switch Announcement frame and b) a New Country subelement in a Channel Wrapper element. A STA that maintains association with the AP after the switch shall use the parameters in these elements and subelements received from the AP in order to maintain regulatory compliance.

**Table D-2—Behavior limits sets**

|  |  |  |
| --- | --- | --- |
| Encoding | Behavior limits set | Description |
| 19 | +80 | In an channel bandwidth that contains 2 or more frequency segments, the frequency segment that does not contain the primary 80 MHz (see Note 2) |
| 20-255 | Reserved | Reserved |
| NOTE 1—The fields that specify the 40 MHz channels are described in 20.3.15.4.  NOTE 2 - For example, an operating class for 80+80 in the Country element is expressed by two consecutive operating triplets, where the first operating triplet is an operating triplet for a 80 MHz channel spacing without a +80 Behavior limit and the second operating triplet is an operating triplet for a 80 MHz channel spacing with a +80 Behavior limit. | | |

**Table E-4—Global Operating classes**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Operating class | Global operating class (see Table E-4) | Channel starting frequency (GHz) | Channel spacing (MHz) | Channel set | Channel center frequency index | Behavior limits set |
| 130 |  | 5 | 80 | - | 42, 58, 106,  122, 138,  155 | +80 |
| 131-179 | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4249 | Brian Hart | 10.22.6.4.1 | 139 | 10 | Operating class expresses bandwidth, position of primary wrt bandwidth (tho there are other ways to solve this problem) AND time/location/AP-state dependence of enabling signal sent to clients by AP, where applicable. So we cannot just terminate the operating class concept at 40 MHz. | Fix. Commenter will bring presentation |  |

***Change Set 7*: Refresh 11d/h/k/s/v frames, elements and fields that using operating classes or channel numbers**

**Future work.**